The Role of Independent Directors in Cartel Prosecutions

Murillo Campello*
Cornell University
& NBER
campello@cornell.edu

Daniel Ferrés
Universidad de Montevideo
& PPSRC–IESE
dferres@um.edu.uy

Gaizka Ormazabal
IESE Business School
& CEPR
gormazabal@iese.edu

This Draft: March 3, 2017

Abstract

Market reactions to news of cartel prosecutions are muted when indicted firms have a high proportion of independent directors on their boards. Independent directors serving on cartel-indicted firms are penalized by losing board seats and vote support in other firms they serve. Notably, firms with more independent directors are more likely to cooperate with prosecutors through leniency programs. They are also more likely to dismiss scandal-laden CEOs after cartel indictments. Our study shows that cartel prosecution imposes significant, market-based personal costs onto independent directors and that they take actions to mitigate those costs. Our results may inform regulatory actions in antitrust enforcement.

Keywords: Cartel Prosecution; Antitrust Policy; Leniency Programs; Independent Directors; Reputational Costs.

JEL Classification: G30, K21, L41.

*Corresponding author. Address: 381 Sage Hall, Samuel Curtis Johnson Graduate School of Management, Cornell University, Ithaca, NY 14853-6201; Phone: 607-255-1282; Email: campello@cornell.edu. We thank Renée Adams, Dennis Carlton, John Connor, Juan Dubra, Mireia Gine, Javier Gomez-Biscarri, Igor Goncharov, Encarna Guillamon, Joe Harrington, Filippo Ippolito, Leslie Marx, Jose Luis Peydro, Miriam Schwartz-Ziv, Daniel Sokol, Valery Suslow, Xavier Vives, and seminar participants at Cambridge University, IESE, INSEAD, EFA Annual Meeting (Oslo), FMA Napa Conference, Lancaster University, MIT, Northwestern University, Pompeu Fabra, Universidade Católica/Nova de Lisboa, Universidad de Montevideo, and WFA Annual Meeting (Park City) for useful comments and suggestions. Campello, Ferrés and Ormazabal acknowledge funding from the Centro de Gobierno Corporativo de la Universidad Católica (Chile). Ormazabal acknowledges funding from the Ramon y Cajal and Marie Curie Fellowships and the Spanish Ministry of Science and Innovation.

"Crompton is a prime example of a company whose independent board of directors decided to leave no stone unturned in its commitment to investigate, identify and report antitrust violations...[T]he board's strategy resulted in the company receiving an extraordinary reduction in its rubber chemicals fine. Crompton's early cooperation allowed the Division to conserve and focus its resources and to immediately put additional pressure on other subject companies and individuals to cooperate."

— Scott D. Hammond, U.S. Department of Justice Antitrust Division's Deputy Assistant Attorney General for Criminal Enforcement, March 2006

1 Introduction

The prosecution of price-fixing cartels is an issue of primary interest around the world, yet there is substantial debate about optimal prosecution policies. At the heart of the debate is the determination of sanctions. The establishment of individual penalties, in particular, is one of the issues that generates most disagreement. On that front, a key difference between European and US antitrust laws is that the US legislation contemplates criminal sanctions not only for corporations, but also for individuals.

This paper contributes to the debate on cartel prosecution by identifying and examining market-based penalties for individuals in firms involved in price-fixing. It also assesses whether such penalties are significant enough to influence corporate insiders' behaviors. This examination is important because setting socially-efficient civil and criminal sanctions requires understanding the complementary effect of potential penalties imposed by the market. Our analysis focuses on independent board directors. We consider this set of corporate insiders for several reasons.

First, focusing on independent directors is likely to result in powerful tests as these individuals are highly sensitive to market sanctions (e.g., in the form of reputational losses). Notably, the legal literature provides several explanations about ways in which directors play a role in cartel prosecutions. Not only do they order internal investigations, but also require officers and employees to cooperate with prosecutors. In some cases, boards also establish special committees and appoint outside counsel to consider leniency applications (see Mahinka (2004) and Marx et al. (2015)). Independent directors thus constitute a set of corporate insiders antitrust authorities can exploit in designing prosecution policies.

Second, focusing on independent board directors facilitates the task of identification in empirical testing. In particular, while the potential effect of reputational losses on managers could be confounded by simultaneous civil and criminal penalties, outside directors are rarely subject to court-monitored economic sanctions or imprisonment. In addition, independent directors generally have more modest direct ("less convex") economic interest in the firm's profits than managers and other corporate officials (who often receive stock- or option-based compensation packages). As such, independent directors' upside from cartel involvement is less likely to compensate for the costs of being associated with corporate misbehavior.

However, it is possible that the market does not impose significant penalties on independent directors of firms involved in cartels. Relative to top executives in charge of the daily operations of the firm, outside directors may be less likely to be aware of corporate misbehavior and thus likely to be granted the presumption of innocence by the market. That being said, these arguments do not eliminate the possibility that the cartel posecution harms independent director's reputation. And even if those directors are not believed to be the architects of price-fixing, the firm's involvement in such schemes could be seen as evidence of incompetence.

We study cartel prosecutions using a comprehensive set of US public firms indicted by antitrust authorities across various international jurisdictions between 2002 and 2012. As a starting point, we analyze the stock market reaction to first-time news concerning cartel prosecutions. In particular, we model abnormal equity returns to cartel indictments as a function of the proportion of independent directors serving on the boards of the firms cited. Consistent with the expectation that personal costs from cartel involvement prompt independent directors to take corrective action, we find that firms with larger fractions of independent directors on their boards observe significantly smaller value losses around cartel-busting episodes. Diferently put, the presence of independent directors mitigates the cost of cartel prosecutions onto public market equity investors. The magnitude of the variation in equity returns is substantial. A baseline estimation suggests that a one-standard deviation increase

in director independence — a mere 1- or 2-person increase in the number of independent directors in the average firm — is associated with nearly 100 basis points higher average one-day return around announcements involving cartel investigations. This pattern is robust to the inclusion of a host of control variables and industry- and jurisdiction-fixed effects, suggesting that the pattern we document is robust to a number of sources of unobserved variation.

To better characterize our results, we employ an approach where we vary the degree of independence of director's appointment to the firm's board. In particular, we consider situations where our sample independent directors' appointments were less attributable to the direct influence of indicted CEOs; exploiting cases, for example, in which director's appointments were made for mandatory compliance with SOX, preceded their indicted CEOs' tenure, or followed class action suits initiated by shareholders, among others. Our results show that the market responds even more favorably to the presence of these types of "independently-appointed" independent directors on the boards of indicted firms following news of prosecution. Notably, the more plausibly extraneous conditions we add to these directors' appointments, the stronger are the estimated mitigating effects of independent directors.

Beyond tests performed on *de facto* persecuted firms, we also explore the effect of prosecutory announcements on *potential targets* of antitrust enforcement. In practice, the discovery of price-fixing schemes often triggers further investigation of collusive practices in an industry (see Hammond (2009)). That is, a public indictment raises the odds that peer firms operating in the same industry are also indicted. Our tests show that when the industry-wide expected probability of prosecution increases, unprosecuted firms also experience equity returns that are positively related to the proportion of independent directors on their boards. This evidence informs the debate on the efficacy of antitrust policy by showing that there are measurable externalities in cartel prosecutions and that economic spillovers are shaped by the presence of independent directors on corporate boards.

Next, we turn to direct evidence regarding reputational costs that independent directors bear for their involvement with cartel-indicted firms. Our analysis shows that, following

prosecution announcements, directors of firms involved in cartels lose a significant number of directorships in *other firms*. Notably, even when directors do not lose positions in other firms, they still lose voting support across their portfolio of outside directorships. These results reveal that professional directors of cartel firms observe significant labor-market reputational costs following regulatory indictments.

In the last part of our analysis, we provide evidence of the proactive role played by independent directors in cooperating with antitrust authorities, as well as in punishing managers involved in price-fixing schemes. We do so by examining two dynamics that take place around cartel prosecutions. First, we examine the relation between the probability of applying for leniency and the presence of independent directors on boards. We show that firms with a higher proportion of independent directors on their boards are much more likely to apply for leniency programs during the course of cartel prosecutions. Second, we show that firms with a higher proportion of independent directors are also more likely to replace their scandal-laden CEOs following cartel prosecution announcements. These results indicate that independent directors favor the implementation of corrective actions that aim at mitigating reputational damage arising from price-fixing scandals.

Our paper contributes to several strands of research. First, it adds to the economics literature on price-fixing cartels. Earlier empirical work (e.g., Posner (1970) and Hay and Kelley (1974)) examined the effect of industry characteristics (number of firms, homogeneity of goods sold, barriers to entry, and price elasticity of demand) and external factors (demand fluctuations and technological change) on cartel formation and stability. More recent contributions (e.g., Dick (1996), Genesove and Mullin (2001), and Levenstein and Suslow (2006, 2011)) have emphasized the importance of the cartel internal structure (self-enforcement, service to members, and information-sharing arrangements). We add to this literature by emphasizing a corporate governance dimension, showing that individual firm's internal organization should be considered in the antitrust policy debate.

Second, our work relates to the nascent research on antitrust leniency programs. While the general conclusion from the theoretical literature is that leniency programs make collusion

more difficult, recent work suggests that these programs can lead to more cartel formation (recent studies on the efficacy of leniency programs include Miller (2009), Brenner (2009), and Dong et al. (2014)). Our paper pushes forward the understanding of the efficacy of leniency programs by focusing on a different angle: the role played by independent board directors.

Third, our paper extends prior work on the role of reputation as a market-based penalty that should be considered when determining criminal, civil, and administrative sanctions in the prosecution of cartels. Regarding reputational costs at the firm level, prior literature finds that some types of misconduct, such as fraud, are associated with significant losses (see, e.g., Alexander (1999)). However, for other types of misconduct, such as environmental violations, there is no evidence of losses (e.g., Karpoff et al. (2005)). The evidence on whether individual-level reputational incentives are strong enough to fight corporate misconduct is mixed.[1] Notably, none of the existing studies have looked at cartel scandals, which are serious violations of corporate conduct. Our paper identifies and measures the individual-level losses directors suffer as a result of cartel scandals, showing they are economically significant.

The remainder of the paper proceeds as follows. Section 2 provides background on cartel prosecution. Section 3 describes the sample and the key variables used in our study. We analyze stock market reactions to cartel prosecutions in Section 4. The consequences of cartel prosecution for individual directors are presented in Section 5. Section 6 considers independent directors' actions around cartel prosecutions. Section 7 concludes.

2 Institutional Setup

2.1 Background on Cartel Prosecution and Leniency Programs

Antitrust actions have increased dramatically in recent years both in the US and in the EU. The surge in cartel prosecution activity has been preceded by an increase in the penalties associated with price-fixing and the introduction of leniency programs. Regarding penalties,

[1] See, e.g., Helland (2006), Agrawal et al. (1999), Fich and Shivdasani (2007), and Ertimur et al. (2012).

the US introduced the Antitrust Criminal Penalty Enhancement and Reform Act (ACPERA) in 2004. ACPERA increased the maximum corporate fine to $100 million, the maximum individual fine to $1 million, and the maximum prison term to 10 years. Under the alternative fine provision, corporations and individual defendants can be fined up to twice the financial gain resulting from a violation. In Europe, antitrust fines were substantially revised in 2006.

Leniency programs define rules for granting reductions in penalties to firms or individuals that step forward to report participation in cartel activities and provide active cooperation in investigations conducted by enforcement authorities. In the US, the Corporate Leniency Program was introduced in 1978 to grant full amnesty to the first informant firm. The program was amended in 1993. In 1994, the US DOJ introduced the Leniency Policy for Individuals, and in 1999 created "Amnesty Plus" to decrease penalties in exchange for information about other cartels in which investigated firms were involved. Leniency programs were introduced in Europe in 1996.

The theoretical literature on antitrust action highlights the trade-offs faced in regulating cartel prosecutions. Some researchers argue that leniency programs can be an effective cartel deterrence tool (Miller (2009) and Brenner (2009)) as the possibility of applying for leniency exacerbates conflicts of interests amongst managers of colluding firms (Aubert et al. (2006) and Harrington (2008)). Others, however, argue that because firms can obtain lower fines from cooperation with prosecutors, the existence of leniency programs reduce the expected costs of cartel involvement (Motta and Polo (2003) and Spagnolo (2004)).

Theoretical work also proposes that corporate governance is likely to play a role in cartel activity, since joining a cartel is decided at the very top of a firm's hierarchy. Prior studies posit that certain corporate governance structures and managerial compensation schemes may facilitate collusive agreements (Harrington (2006) and Buccirossi and Spagnolo (2008)). From an empirical perspective, the role of governance on cartel activity remains remarkably understudied. To our knowledge, no prior study empirically examines how the incentives of different firm officials shape the prosecution of cartel schemes.

2.2 The Role of Corporate Boards in Cartel Investigations

Cartel investigations arise from several sources: governmental agencies investigating other corporate conduct, formal complaints, amnesty applications, and proactive efforts by antitrust authorities. In the early stages of a cartel investigation, antitrust agencies use covert methods to gather evidence in many of the same ways other governmental agencies gather evidence to prove other types of crimes.

Typically in the US, the board of directors of an investigated firm learns about the ongoing cartel investigation when the DOJ issues subpoenas to request documents. Once the corporation learns that is the target of a cartel investigation, board action is required to authorize an internal investigation and to require officers and employees to cooperate with it (see Mahinka (2004)). The investigation is customarily conducted by the outside counsel of the firm, who will report either to a Special Committee of the board of directors or to the Audit Committee. Upon completion of the internal investigation, outside counsel will inform the board about the nature of the conduct and the potential problems involving the company. Counsel will make a report about the direct and collateral consequences to the company of its participation in the suspected illegal activity. It will also present to the board the risks and benefits of making an application for leniency.

Corporate leniency applications occur once a thorough internal investigation is conducted and the board of directors supports the filling of the application. Based on interviews with defense attorneys experienced in taking firms through the leniency process, Marx et al. (2015) estimate that 80–90% of the corporate leniency applications occur in the context of an ongoing DOJ investigation (Type B leniency), while 10–20% take place before the DOJ has opened an investigation (Type A leniency).

3 Data and Variable Construction

Our analysis is based on data from the Private International Cartels (PIC) database.[2] The PIC database contains information on the universe of private international cartels detected since 1990 (see Connor (2014) for a detailed description). The data include the indicted firm's name, country of incorporation, the markets and locations where collusion took place, the duration of the collusive agreement, the fines imposed, and whether the firm was granted amnesty under a plea deal.

Some cartels are first revealed to the public when fines, a guilty plea, or an indictment is announced in press releases by the relevant antitrust authority. In other cases, cartel investigations are first known by the public due to the revelation of investigative events, such as surprise inspections conducted by an investigating antitrust agency. We define *First Notices* as the date when a cartel investigation is first publicly revealed. Information on *First Notices* is collected from press releases of antitrust authorities, such as the US Department of Justice, the Canadian Competition Bureau, the European Commission, and other national authorities with active anti-cartel programs. *First Notices* dates are also obtained from business newspapers, trade magazines, and news services.

We select firms headquartered in the US with non-missing Compustat and CRSP data for our analyses. Because our tests necessitate detailed data on board characteristics, we require that the firms are covered by Equilar.[3] These refinements result in a sample of 192 American public firms involved in 200 cartels prosecuted by 41 antitrust authorities from 2002 to 2012. The number of observations used in the tests below varies according to the level of the targeted analysis. In all, our sample includes 374 firm-cartel observations, 520 firm-year observations, 580 firm-cartel-jurisdiction observations, and a total of 547 announcements.

[2]The term "private" in the context of cartels is used to differentiate illegal price-fixing schemes from ("public") price agreements protected by government sovereignty or by international treaties, such as OPEC. The term "international" indicates that the cartel is formed by (1) at least one corporate participant with headquarters, residency, or nationality outside the jurisdiction of the investigating antitrust authority, or by (2) at least two members with different nationalities (cf. Department of Justice (2013)).

[3]The Equilar database provides board composition data collected from annual proxy filings (DEF 14A) with the SEC. The database covers a large number of firms starting from fiscal year 2001.

Table 1 presents descriptive statistics for the firms and cartels included in the sample. Panel A shows that sample firms cover a wide range of industries with a relatively high representation of producers of chemicals and allied products, consumer nondurables, manufacturing, as well as financials.

Table 1 About Here

Panel B presents statistics of the following core characteristics of the sample firms: *Independent_Directors* is the number of independent directors scaled by the total number of firm directors;[4] *MV* is the firm's equity market value; *BM* is the firm's book-to-market ratio; *Stock_Return* is the firm's market-adjusted return over the past year; *ROA* is the firm's return on assets, computed as annual operating income before depreciation scaled by total assets; *Leverage* is the leverage ratio of the firm, computed as total debt scaled by total assets; and *Volatility* is the market-adjusted stock return volatility of the firm. All of these proxies are measured using the most recent accounting and market data prior to the prosecution announcement. Appendix A provides detailed descriptions of all variables used in this paper.

Not surprisingly, cartel firms tend to be large. The mean (median) market capitalization of cartel firms is \$43,528 (\$10,813) million, while the mean (median) market capitalization of the firms in the CRSP-Compustat universe during the sample period is \$2,794 (\$275) million. Panel B shows that cartel firms have relatively low book-to-market ratios and are comparatively more profitable, but not riskier than the typical firm in the CRSP-Compustat universe.

Panel C presents statistics on the characteristics of the 200 cartels in which the sample firms were involved. *Number_Participants* is the number of firms involved in the cartel. *Duration* is the number of years from the beginning to the end of the cartel. *Cartel_Sales* is the total revenues of the cartel firms during the collusive period (expressed in \$ million). *Fines_Cartel* is the total amount of monetary fines imposed on all of the firms that

[4]Following NYSE and NASDAQ listing rules, we define a director as "independent" if the director has no material relationship with the listed company, either directly or as a partner, shareholder or officer of an organization that has a relationship with the company (see https://www.sec.gov/rules/sro/34-48745.htm).

participate in a given cartel (in $ million). Two characteristics warrant attention. First, the average volume of sales affected by sample cartels is substantial ($49 billion). Second, firms receive substantial fines for cartel involvement ($138 million per cartel, on average).

4 Independent Directors and the Market Reaction to Cartel Prosecutions

4.1 Equity Returns

Our first set of tests focuses on stock market reactions to first-hand publicly-revealed news about a firm's involvement in a cartel prosecution. This test allows us to examine whether the presence of independent directors on the boards of cartel-indicted firms mitigates the costs that the prosecution process imposes on those firms' shareholders. We gather relevant dates for each cartel case in which sample firms are involved and for each jurisdiction in which the cartel is prosecuted. As an exploratory analysis of the value effect of independent directors, we partition the sample into firms with above-median (dotted line) and below-median (solid line) values of *Independent_Directors*. As shown in Figure 1, both groups of firms experience negative returns around prosecutory announcements. However, firms with higher values of *Independent_Directors* exhibit markedly less negative returns.[5]

More formally, we examine the association between announcement returns and the percentage of independent directors by estimating the following regression model:

$$\begin{aligned} Abnormal\_Return_{i,t} = \beta_0 + \beta_1 Independent\_Directors_{i,t-1} + \beta_2 FirmControls_{i,t-1} \\ + \beta_3 CartelControls_{i,t-1} + \epsilon_{i,t}, \end{aligned} \tag{1}$$

where i indicates the firm and t indicates the date of the announcement. *Abnormal_Return* is the market-adjusted return on the dates of the first notices of cartel investigations

[5]The difference in returns between the two groups in Figure 1 is statistically significant and robust to alternative measures of returns (e.g., market-adjusted buy-and-hold raw returns, or average abnormal returns computed using a 3-factor Fama-French plus momentum model).

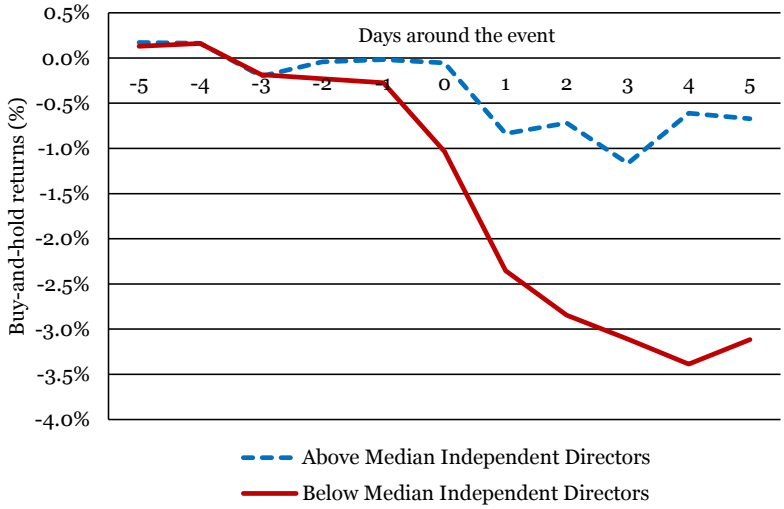

Figure 1. Cartel Detection and Board Independence. This figure plots average cumulated (buy-and-hold) returns of cartel firms over a window (–5, +5) days around the first announcement of prosecution for each of the sample cartels. *Below Median Independent Directors* refers to the firms with below-median percentage of independent directors. *Above Median Independent Directors* refers to the firms with above-median percentage of independent directors. The left vertical axis indicates average buy-and-hold returns (in %) for each one of the groups of firms. The horizontal axis indicates the number of days before and after the first announcement of cartel prosecution.

(expressed in percentage terms). *Independent_Directors* is the percentage of independent directors on the board. Eq. (1) includes controls for variables found by prior literature to be associated with the cross-section of stock returns. *FirmControls* is a vector of variables that includes *Size*, *BM*, and *Stock_Return*. *CartelControls* includes the logarithmic transformations of *Number_Participants*, *Duration*, *Cartel_Sales*, and *Fines_Cartel*. Finally, we include jurisdiction- and industry-fixed effects to control for antitrust authorities' institutional characteristics and industry characteristics.[6] Standard errors are clustered at the cartel level to account for the fact that errors for observations coming from the same cartel may be correlated.

Table 2 presents the results from estimating Eq. (1). The estimations suggest that the proportion of independent board members is positively associated with the prose-

[6]To mitigate concerns about our inferences being confounded by cross-sectional variation in cartel characteristics, we also estimate Eq. (1) using cartel-fixed effects. We do not present those results in Table 2, given that including cartel-fixed effects excludes a significant number of sample cartels that only contain one observation. Still, the untabulated results lead to identical inferences as those that we present in the table.

cution announcement returns; the coefficient on *Independent_Directors* is positive and significant across all specifications. The magnitude of the univariate coefficient on *Independent_Directors* is 5.65 (untabulated result). This implies that a one-standard deviation increase in *Independent_Directors* (i.e., 15%) is associated with an average increase of 84 basis points in daily returns on days containing news about cartel prosecution announcements.[7]

TABLE 2 ABOUT HERE

Our results reveal a strong association between equity returns around the announcement of cartel prosecutions and the proportion of independent directors serving on prosecuted firms' boards. In particular, the presence of independent directors mitigates the negative value effects of those announcements. These results are unique in suggesting that the stock market participants anticipate that independent directors play a positive role in reducing the costs of prosecuting illicit activities. Subsequent analyses will examine various incentives independent directors have to act into mitigating the costs of cartel activities. It will also identify particular actions independent directors take in correcting corporate wrongdoing.

4.2 Varying Degree of Director Independence

We explore the sensitivity of our results to variation in the nature of *independence* accross the non-executive board members of the cartel firms. This analysis is based on an in-depth examination of the sources of cross-sectional variation in our key independent variable, *Independent_Directors*. In particular, we exploit the fact that director appointments often occur several years prior to the cartel prosecution, under circumstances not necessarily related to the conditions leading to cartel formation and detection. Those appointments

[7]See Appendix B for an alternative specification of Eq. (1) that includes a more extensive set of control variables: *FirmControls* is a vector of variables that includes *Size*, *BM*, *Stock_Return*, *ROA*, *Leverage*, and *Volatility*. *GovernanceControls* includes *Staggered*, *Chair_Insider*, *Busy_Directors*, *Age_69*, *Indep_Director_Holdings*, and *Institutional_Holdings*. *CartelControls* includes *Number_Participants*, *Duration*, *Cartel_Sales*, and *Fines_Cartel*. *CartelFirmControls* includes *Fines_Firm_Pct*, and *Recidivism*. All these variables are defined in Appendix A. The results in Table 2 and Appendix B lead to identical inferences.

are motivated by several different regulatory-, legal- and market-driven factors; factors that are outside of current top management's control. Ultimately, we study whether the positive shareholder value implications of board independence around price-fixing investigations is particularly pronounced when independent directors have fewer ties to the indicted CEO.

Following previous literature, we identify four conditions that are associated with extraneous variation in board independence. In particular, we restrict the definition of "independent directors" to those less likely to have been appointed under the CEO's influence or control and replace *Independent_Directors* with *Independent_Appointments*, a variable that measures the percentage of directors appointed under at least one of the following circumstances: (1) *Appointed at the passage of SOX* equals one if the appointment of the independent director occurred in 2002 (year of the passage of The Sarbanes Oxley Act), and zero otherwise;[8] (2) *Appointed before the CEO's tenure* equals one if the appointment of the independent director occurred before the appointment of the indicted CEO, and zero otherwise; (3) *Appointed after class action suits* equals one if the firm was subject to shareholder litigation during the 12 months prior to the appointment of the independent director, and zero otherwise;[9](4) *Appointed in difficult times* equals one if the industry returns over the 12 months prior to the appointment of the independent director are negative, and zero otherwise. To wit, *Independent_Appointments* is designed to capture the proportion of directors that were not just "nominally independent" at the time of prosecution. For example, if there are 7 independent directors out of 10 board members, and 4 of the independent directors were appointed under the circumstances described above, *Independent_Directors* equals 0.7 while *Independent_Appointments* equals 0.4.

We re-estimate Eq. (1) replacing *Independent_Directors* with *Independent_Appointments*, measured based on the number of directors appointed under at least one, two, or three of the

[8]Prior research (e.g., Linck et al. (2009) and Duchin et al. (2010)) has used similar strategies to empirically identify the effect of independent directors' actions on firm value.

[9]Ferris et al. (2007) show that derivative lawsuits are followed by increased board independence. Cheng et al. (2010) show that defendant firms with institutional lead plaintiffs experience increases in board independence after securities class action lawsuits. We identify whether the firm was subject to shareholder litigation in a given period using data on press releases from the CapitalIQ Key Developments database.

four previously mentioned circumstances. We note that the percentage of observations with non-zero values of *Independent_Appointments* under each of the three alternative characterizations above is 98%, 56%, and 10%, respectively (no sample firm observes the occurrence of the four events at the same time). The sample mean (median) of *Independent_Appointments* is 59.2% (66.7%), 13.3% (7.1%), 1.5% (0.0%), respectively. Table 3 presents results for the three alternative definitions of *Independent_Appointments*. The coefficient on *Independent_Appointments* is consistently positive and statistically significant across all definitions. Notably, the impact of *Independent_Appointments* increases monotonically as we add more circumstances speaking to plausible exogeneity of directors' appointments. This evidence suggests that the directors who play a role in cartel prosecution are unlikely to have been appointed under the scandal-laden CEO's direct influence.

TABLE 3 ABOUT HERE

4.3 Spillover Effects of Cartel Investigations

The discovery of price-fixing schemes often triggers further investigation of collusive practices in an industry. This is an important observation in light of our findings that independent directors mitigate the negative effects of firms directly targeted in antitrust investigations. The mitigating effect we describe could apply not only to firms that are targeted by authorities, but also to peer firms that are likely to be the target of subsequent investigations. A deeper examination of the role of independent directors in cartel prosecutions suggests extending the analysis of the stock market reaction to cartel prosecutions to peer unprosecuted firms — potential targets of future prosecutions. Evidence of measurable externalities in cartel prosecutions and that spillovers are shaped by the presence of independent directors at potential prosecution targets are valuable inputs for the debate on the efficacy of antitrust regulation. This analysis is further interesting in disentangling potentially confounding effects between board composition and prosecution (endogeneity), since these subject firms *are not de facto* prosecuted.

For each firm prosecuted for involvement in a cartel, we identify a sample of unprosecuted industry peers using the text-based approach of Hoberg and Phillips (2010, 2016). These data are based on web crawling and text-parsing algorithms that process the text in the business descriptions of 10-K annual filings on the SEC's Edgar website (see Appendix C for detailed information on the Hoberg and Phillip's data library). Notably, the peer firms we identify are competitors of the cartel firms that *were not* indicted in the prosecutor announcements considered. For each unprosecuted firm, we use two measures of the probability of potential prosecution, E[*Prosecution*]. The first measure equals one if the firm is prosecuted several years into the future (i.e., if the firm appears in the PIC dataset because of prosecutions in later years). The second measure is computed as the fitted value of a logit model that predicts the probability of cartel prosecution.[10]

Figure 2 plots average cumulated returns of a hedge portfolio of unprosecuted peer firms. The portfolio is constructed by going long (short) on firms with above-median (below-median) percentage of independent directors around the cartel prosecution announcements. We separately analyze the returns for two categories of firms: *High E*[*Prosecution*] (see dotted line) refers to the peer firms that are more likely to undergo a future cartel prosecution (i.e., peer firms with above-median values of the first proxy for E [*Prosecution*] described above); *Low E*[*Prosecution*] (see solid line) refers to the peer firms that are less likely to undergo a future cartel prosecution (i.e., peer firms with below-median values of the first proxy for E [*Prosecution*] described above). As shown in Figure 2, the buy-and-hold returns of going long (short) on firms with above-median (below-median) percentage of independent directors is in the range of –1 to –2% for the group of unprosecuted firms that are more likely targets of a new price-fixing investigation (i.e., for the group of firms in *High E*[*Prosecution*]). On the other hand, those returns are about zero for the group of unprosecuted firms that are less likely targets of a new price-fixing investigation (i.e., for the group of firms in *Low E*[*Prosecution*]). Figure 2 is remarkable in illustrating that the

[10]Our prosecution probability model follows Shapiro (1989) and Levenstein and Suslow (2006). See Appendix D for a detailed description.

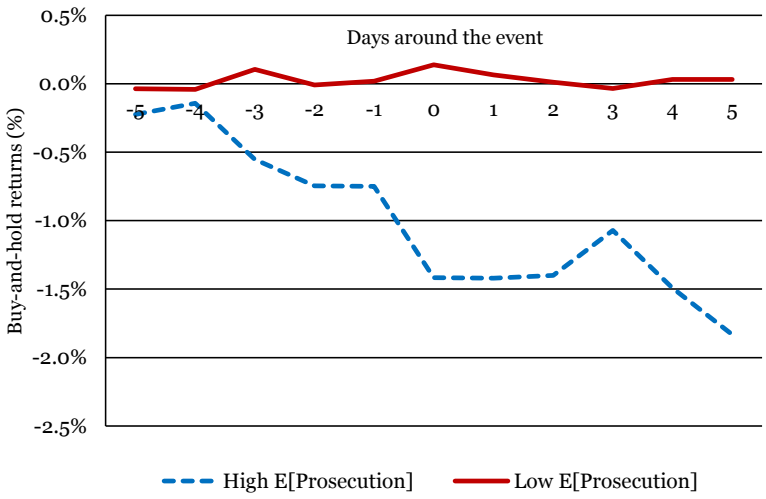

Figure 2. Stock Price Reaction at Peer Firms. This figure plots (equally weighted) average cumulated (buy-and-hold) returns of a hedge portfolio of unprosecuted peer firms. The portfolio is constructed by going long (short) on firms with above-median (below-median) percentage of independent directors. We classify unprosecuted peer firms into two groups. *Low* (*High*) E[*Prosecution*] refers to the peer firms with below median (above median) values of *Future_Prosecution*, defined as one if the firm is prosecuted in the future (i.e., if the firm appears in the PIC dataset in later prosecutions). Peers of cartel firms are defined using Hoberg and Phillips (2010, 2016)'s textual analysis. Returns are cumulated over a window of (–5,+5) days around the first announcement of prosecution for each of the sample cartels. The left vertical axis indicates average portfolio buy-and-hold returns (in %) for each one of the groups of firms. The horizontal axis indicates the number of days before and after the first announcement of cartel prosecution.

role of independent directors on cartel investigations extends to unprosecuted firms that are likely targets of a potential price fixing prosecution.

More formally, we examine the association between announcement returns and the percentage of independent directors in unprosecuted firms by estimating the following regression model:[11]

$$\begin{aligned} Abnormal\_Return_{j,i,t} = \beta_0 + \beta_1 E[Prosecution]_{j,t-1} + \beta_2 Independent\_Directors_{j,t-1} + \\ + \beta_3 E[Prosecution]_{j,t-1} * Independent\_Directors_{j,t-1} \\ + \beta_4 FirmControls_{j,t-1} + \beta_5 CartelControls_{i,t-1} + \epsilon_{j,i,t}, \end{aligned} \quad (2)$$

where j indicates the unprosecuted peer, i indicates the prosecuted firm and t indicates the date of the announcement. *Abnormal_Return* is the market-adjusted return on the

[11]For robustness, we repeat the analysis defining as peers the firms in the same 4-digit SIC code of the prosecuted firm. Estimating Eq. (2) using this alternative sample of peer firms results in identical inferences.

dates of the first notices of cartel investigations (expressed in percentage terms). *Independent_Directors* is the percentage of independent directors on the board of the unprosecuted firm. For each unprosecuted firm, we use the two measures of the probability of potential prosecution (E[*Prosecution*]) described above. Eq. (2) also includes the same sets of control variables and fixed effects used in our prior tests. Standard errors are clustered at the cartel level.

Table 4 presents the results from estimating Eq. (2). The negative coefficient on E[*Prosecution*] reveals the equity losses of unprosecuted firms that are likely to be the target of subsequent cartel investigations upon the announcement of a cartel prosecution in their industries. More importantly, the positive and significant coefficient on the interaction between E[*Prosecution*] and *Independent_Directors* suggests that, among unprosecuted firms, expected losses stemming from prosecution are much lower for firms with a higher percentage of independent directors on their boards.

TABLE 4 ABOUT HERE

The results in Figure 2 and Table 4 suggest that inferences about the role of independent directors in prosecuted firms extend to unprosecuted firms that are likely to be prosecuted. Finding that the role of independent directors on cartel prosecution also extends to unprosecuted firms is particularly interesting from a regulatory perspective, as it speaks to implications of independent directors' behavior in anticipation of a cartel prosecution.

5 Independent Directors' Losses around Cartel Prosecutions

We substantiate our argument about independent directors' incentives to act around cartel prosecution by studying whether those directors observe negative consequences from their involvement with cartels. That independent directors bear significant personal costs

from public indictments would suggest that they are prompted to take actions to mitigate those costs. Understanding this incentive dynamic can be particularly useful for prosecutors.

5.1 Loss of Directorships

We first study whether independent directors lose board seats after news about cartel scandals emerge. Although board directors are rarely publicly fired, they are often pressured to leave their seats after corporate misconduct. Previous literature documents that directors are more likely to leave their seats after news of financial irregularities (see, e.g., Srinivasan (2005), Fich and Shivdasani (2007), and Ertimur et al. (2012)).

We refer to the directors serving on the board of our sample of prosecuted firms as "cartel directors." For each cartel director, we collect data on whether the director departs from his/her directorships in year $t+1$ (t being the year in which there is a prosecution announcement). We find that cartel directors experience significant turnover following prosecution. The departure frequency is 11.3% from prosecuted directorships (which we refer to as "cartel directorships") and 9.3% from unprosecuted directorships ("non-cartel directorships"). In this section, we focus on the latter group, namely cartel directors' non-cartel directorships (positions in firms that are not indicted by antitrust authorities). There are 4,453 director-firm-year observations in this category.

To provide a benchmark for cartel directors' departure rate from non-cartel directorships, we compare director departure frequency in our "treatment group" to director departure frequency in a set of four alternative control groups. First, we compare the treatment group to all director-firm observations with non-missing data in BoardEx in which neither the firm nor the director are involved in cartel prosecutions during our sample period.

Second, we compare the treatment group to a sample of director-firm pairs from the universe of public firms in BoardEx obtained using propensity-score matching. Specifically, for each director-firm observation in the treatment group, we use Derigs' (1988) propensity score matching algorithm to find the observation in the BoardEx universe of unprosecuted

director-firm observations that is closest in terms of firm and director characteristics. Specifically, we consider the following firm characteristics: *Size*, *BM*, *Stock_Return*, *ROA*, *Leverage* and *Volatility*.[12] We consider two director characteristics that are likely to be associated with the probability of directorship departure. First, since older directors are more likely to retire, we include the age of the director in a given year (*Age*). We also include the director's total number of directorships in a given year (*NBoards*). This variable is a proxy for the director's reputation (see Masulis and Mobbs (2014)) and is included to control for variation in the personal cost of departing from a directorship.

Third, to control for potentially confounding effects of unobserved director characteristics, we compare the treatment group to cartel directors' directorships in "non-prosecution years" (years with no prosecution announcements). That is, this control group includes the same directors as the treatment group (cartel directors), but different directorship-year observations for those directors; similar to a "within-director" fixed effect model.

Fourth, to control for unobserved firm characteristics, we compare the treatment group to cartel directors' co-directors in non-cartel directorships. Specifically, this control group includes directors serving on the same unprosecuted boards as cartel directors in prosecution years (i.e., years in which there is a prosecution announcement at one of the cartel directors' directorships). As such, the treatment and control groups include the same firms, but different directors.

Table 5 presents the results from testing the difference in *Departure_NonCartel* (defined as one if the director departs from that directorship in year $t+1$, and zero otherwise) between the treatment group and each of the four control groups just described. As shown in the table, differences in departure rates are statistically significant in all four tests. The magnitude of the difference varies from 1% to 3% across control groups. These magnitudes are significant considering that the average departure rate in the BoardEx universe is 7.9%.

TABLE 5 ABOUT HERE

[12] We restrict the pool of potential matches to firms in the same years as the treatment firms.

5.2 Loss of Voting Support in Director Elections

We next investigate whether cartel directors lose voting support in director elections following cartel prosecution announcements. This analysis is informative because a lower voting support across directors' portfolio of directorships suggests that these professionals face reputational penalties from cartel involvement even when those penalties might not be strong enough to force immediate resignations accross other directorships. Consistent with the notion that directors care about receiving withhold votes, research has shown that losses in voting support at a firm induce directors to take corrective actions (see e.g., Cai et al. (2009)). Moreover, losses in voting support are known to have relevant negative implications for directors' professional standing (Fischer et al. (2009)).

We analyze changes in voting support after cartel prosecution announcements by collecting information on shareholder voting on director elections from the ISS Voting Analytics database.[13] The database includes voting data since 2003 and covers companies included in the Russell 3000. We again contrast changes in voting support between the treatment group of cartel directors' unprosecuted directorships against various alternative control groups. For each director-firm-year observation, we compute $\Delta Support\_NonCartel_{d,i,t}$ as the percentage of "For" votes for director d at firm i at the annual meeting of year t minus the percentage of "For" votes for director d at firm i at the annual meeting of year t–1. The mean value of $\Delta Support\_NonCartel$ in the treatment group is –1%, implying that cartel directors lose significant voting support after cartel prosecution news.

Table 6 presents the results. The mean value of $\Delta Support\_NonCartel$ is –1.04% (p-value < 0.01) in the treatment group and not statistically different from zero in the four control groups. The standard deviation of $\Delta Support\_NonCartel$ is 8%, implying that a non-trivial percentage of cartel directors experience a considerable increase in withheld votes.[14] These

[13] ISS compiles shareholder votes for all agenda items at a firm's shareholder meetings, including director elections. The database provides the identity of the companies holding elections, the shareholder meeting date, the agenda item descriptions, and the voting results.

[14] To interpret the magnitude of $\Delta Support\_NonCartel$ it is important to consider that the mean (median) voting support at director elections in the ISS Voting Analytics database is 94.8% (97.6%). The 25^{th} percentile is 94.5%, suggesting that an 8% decrease in support would place the director in the left tail of the distribution of voting support.

results confirm that, after cartel prosecution news, directors of cartel firms lose voting support across their portfolio of directorships.

TABLE 6 ABOUT HERE

The evidence in Tables 5 and 6 suggests that independent directors are disciplined by the market in various, significant ways following news of their involvement with cartel firms. This happens regardless of whether they are held personally accountable for illicit behaviors by antitrust authorities. Our findings suggest that, in addition to corporate fines and individual criminal and civil sanctions, there are sizable individual, market-based penalties stemming from involvement with cartels. They imply that independent directors have measurable incentives to aid antitrust authorities and corporate investors in correcting wrongdoing. We examine this hypothesis in more depth in turn.

6 Directors' Actions around Cartel Prosecutions

6.1 Leniency Applications

One important action directors can take to mitigate the costs of prosecution is to encourage their firms to cooperate with antitrust authorities under leniency programs. Leniency programs grant amnesty regarding criminal penalties and reduce future exposure to civil damages claims brought by private parties.[15] Leniency applications may reduce reputational damage to the extent that the market interprets cooperation with authorities as directors fulfilling their role of corporate monitors.

Under the US DOJ Antitrust Division's Corporate Leniency Program, companies and individuals can avoid criminal conviction, prison terms, and fines, by being the first to confess participation in a criminal antitrust violation and cooperating with the Antitrust

[15]Leniency programs have been described by legal scholars as "the cornerstone of the Antitrust Divisions cartel enforcement regime because they create powerful incentives for self-reporting by wrongdoers that can have a significant destabilizing effect on a conspiracy" (Varney (2013)).

Division. This can be done either before or after an investigation has begun. Under the program, only the first qualifying corporation may be granted full pardon. Leniency programs give incentives for conspiring firms to self-report ilegal price-fixing even at later stages of an investigation.

The identity of leniency applicants is public information in the EU and other international jurisdictions. While the US leniency program offers confidentiality to leniency applicants, relevant information can be gathered from public disclosures of fines, court disclosures in connection with litigation following prosecution, and firms' voluntary disclosures (see Connor (2009)). This allows us to examine whether independent directors play a role in leniency applications.

We use multivariate analysis to study whether there is a positive association between the presence of independent directors and the probability that the firm cooperates with antitrust authorities. Leniency applications are jurisdiction-specific and we consider all the jurisdictions in which a sample firm is prosecuted for a given cartel. We estimate the following OLS regression:[16]

$$\begin{aligned} Leniency_{i,j,t} = \beta_0 + \beta_1 Independent\_Directors_{i,t-1} + \beta_2 FirmControls_{i,t-1} \\ + \beta_3 CartelControls_{i,t-1} + \epsilon_{i,j,t}, \end{aligned} \tag{3}$$

where i indicates the firm, j indicates the jurisdiction and t indicates the year of the prosecution. The dependent variable *Leniency* equals one if the company applies for leniency, and zero otherwise. *FirmControls* is a vector of variables that includes *Size*, *BM*, *Stock_Return*, *ROA*, *Leverage*, and the natural logarithm of *Volatility*. *CartelControls* includes the natural logarithm of *Number_Participants*, *Duration*, *Cartel_Sales*, *Fines_Cartel*. Eq. (3) also includes industry- and jurisdiction-fixed effects. Standard errors are clustered at the cartel level.

[16]Estimating Eq. (3) using logit or probit models results in identical inferences.

Table 7 presents results from estimating Eq. (3). The coefficient for *Independent_Directors* is positive and significant across various different model specifications. The estimation under column (1) suggests that an increase of one standard deviation in *Independent_Directors* is associated with an increase in the probability of applying for leniency of close to 2.5% (the coefficient ranges from 0.15 to 0.22). The unconditional probability is 9.1%, suggesting that the magnitude of our estimate is very significant. That estimate remains the same even after the inclusion of an exhaustive set of fixed effects into our base specification.

TABLE 7 ABOUT HERE

Our results are consistent with the argument that independent directors favor cooperation with antitrust authorities to mitigate personal costs arising from prosecution. This is an important finding considering the increasing emphasis placed on leniency programs in recently-proposed antitrust regulation. Indeed, a recent report by the Government Accountability Office (GAO) to the US Congress indicates that the number of leniency applications concerning cartel activity about which the DOJ had no prior knowledge nearly doubled with the passage of ACPERA (see GAO (2011)).

6.2 CEO Departures Following Cartel Prosecutions

The risk of incurring personal costs from cartel prosecution should induce independent directors to take actions that enhance their reputation as monitors committed to punishing fraudulent behavior. An especially important disciplinary action the board can take is to force the replacement of the CEOs of the prosecuted firm. In this section, we test whether firms with a higher proportion of independent directors are more likely to replace their CEO after cartel prosecutions. As a (high) benchmark for price-fixing CEO's departure rate, we compare CEO turnover in cartel firms and in unprosecuted peer firms.

We collect data on CEO departures in the years in which there is news of cartel prosecution for two samples: cartel firms and their unprosecuted industry peers. First, using each sample separately, we estimate the following OLS regression model:[17]

$$CEO\_Departure_{i,t} = \beta_0 + \beta_1 Independent\_Directors_{i,t-1} + \beta_2 FirmControls_{i,t-1} + \beta_3 CartelControls_{i,t-1} + \epsilon_{i,t}, \quad (4)$$

where i indicates the firm and t indicates the year of the prosecution news. For each firm i, *CEO_Departure* equals one if the CEO leaves the firm within the 12 months after the first news of cartel prosecution in year t, and zero otherwise. Eq. (4) includes the same sets of control variables and fixed effects used in our prior test. Standard errors are clustered at the cartel level.

The results in Table 8 reveal a positive association between *Independent_Directors* and *CEO_Departure* for the sample of cartel firms (only). The coefficient of 0.16 in column (1) implies that an increase of one standard deviation in *Independent_Directors* is associated with a 2.4% increase in the probability of CEO turnover. When using the sample of unprosecuted peer firms to estimate Eq. (4), in contrast, we find that the coefficient of interest is not statistically different from zero (see column (2)). We pool the cartel and non-cartel observations to test the difference on the coefficients on *Independent_Directors* across samples. We define *Cartel_Involvement* as a dummy variable that equals one if the firm received a cartel indictment in year t, and zero otherwise. As shown in column (3) in the table, the interaction term of *Independent_Directors* and *Cartel_Involvement* is positive and statistically significant. The results in Table 8 are consistent with the argument that independent directors replace their scandal-laden CEOs at very high rates following formal cartel detection in an effort to enhance their reputations as monitors.

TABLE 8 ABOUT HERE

[17]Estimating Eq. (4) using logit or probit models results in identical inferences.

6.3 Board Independence and Cartel Survival

The results in Section 6.1 suggest that firms with a higher percentage of independent directors are more likely to apply for leniency. To the extent that leniency programs can help destabilize cartels, our results imply that independent directors may have an important impact on cartel stability. In this section, we gauge the economic significance and regulatory implications of our results by exploring whether the presence of independent directors on the boards of cartel firms translates into lower cartel duration.

Following prior literature (e.g., Levenstein and Suslow (2011)), we estimate a hazard model of the number of years until a cartel is discovered as a function of the number of independent directors on the boards of the cartel member firms.[18] For consistency, we focus our analysis on cartels that were in existence before the start of our sample period (i.e., 2002).

We first present a univariate analysis of cartel survival rates. Figure 3 plots the survival functions of the subsample of cartels with below-median percentage of independent directors (solid line) and the subsample of cartels with above-median percentage of independent directors (dotted line). The survival function of the latter group exhibits a steeper downward trend, suggesting that cartels formed by firms with a higher percentage of independent directors on their boards experience a significantly lower probability of survival.[19]

Table 9 presents multivariate analyses of cartel survival. *Independent_Directors* is the cartel-level average of cartel firms' percentage of independent directors. *FirmControls* is a vector of variables including the cartel-level average of *Size*, *BM*, *Stock_Return*, *ROA*, *Leverage*, and *Volatility*. *CartelControls* includes the natural logarithm of *Number_Participants*, *Duration*, *Cartel_Sales*, and *Fines_Cartel*. All these variables are as previously defined, except for *Duration*. Given the nature of this test, this variable is re-defined as the number of years between cartel formation and the start of the sample period.

[18]The survival distribution is assumed to be exponential. Our inferences are unaffected by using alternative assumptions about the survival function: Weibull, logistic, normal, or gamma.

[19]In untabulated analyses, we formally test for differences in the survival functions of the two groups. Log-rank and Wilcoxon tests as well as parametric tests of survival probability show statistically significant differences across the groups (as suggested in Figure 3).

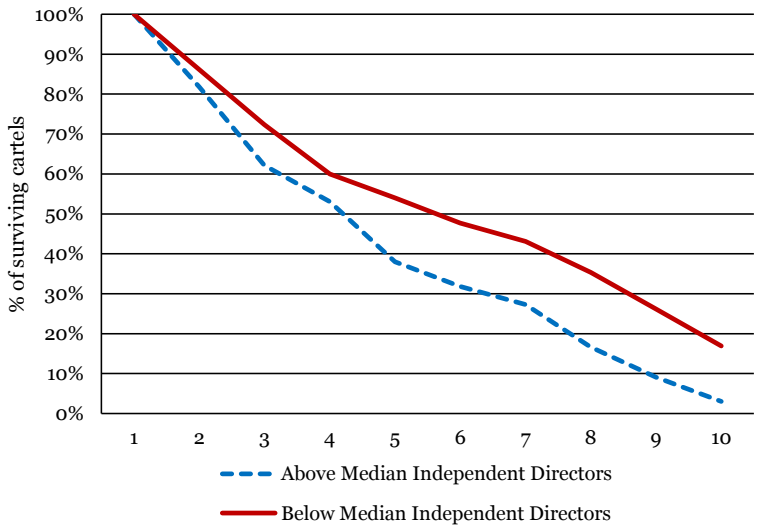

Figure 3. Cartel Survival and Independent Directors. This figure presents survival rates for 125 cartels that were formed prior to the start of the sample period. *Below Median Independent Directors* refers to cartels formed by firms with below-median percentage of independent directors. *Above Median Independent Directors* refers to cartels formed by firms with above-median percentage of independent directors. The horizontal axis indicates the number of years after 2001.

The results in Table 9 confirm that cartels formed by firms with a higher presence of independent directors exhibit significant lower survival rates. The relevant coefficient ranges between –0.83 and –1.84, implying that a one-standard deviation increase in *Independent_Directors* is associated with a decrease of between 8.4% and 12.6% in cartel duration.

TABLE 9 ABOUT HERE

The evidence in Figure 3 and Table 9 is consistent with the notion that independent directors play a significant role in hampering cartel schemes, a role that may be considered in the design of antitrust policies such as leniency programs.

6.4 The Effect of Cartel Prosecution on Board Composition

A question that arises from our findings is whether firms adjust board composition bearing in mind the effect of independent directors on cartel prosecution. Firms could anticipate this effect and hire independent directors *ex-ante* (i.e., before cartel prosecutions).

Alternatively, they could add independent directors *ex-post* (after prosecutions), as a way to avoid recidivism or increase monitoring after the prosecution of an industry peer (cartel prosecutions often trigger follow-up investigations in the industry).[20]

Regarding potential *ex-ante* reactions to the effect of independent directors, one must note that antitrust considerations are one of the many issues that affect board composition; other factors, in contrary, may call for a lower presence of independent directors on boards.[21] That said, this is an important issue, one which we are able to examine empirically. We do so by comparing the percentage of independent directors among our sample cartel firms to that of industry peers. For each sample firm, the corresponding industry peer is defined as the firm with the same 4-digit SIC code that is closest in size. Untabulated tests reveal that our sample firms do not differ from comparable industry peers in terms of the empirical distribution of *Independent Directors*.[22] We also conduct a multivariate analysis of the probability of cartel prosecution as a function of the percentage of independent directors using the CRSP-Compustat universe (see Appendix D for details). We draw the same inference: *Independent_Directors* is unrelated to the probability of cartel prosecution (untabulated).[23]

Regarding *ex-post* reactions to the effect of independent directors, we first explore whether firms in industries with a past history of cartel behavior exhibit a higher proportion of independent directors on their boards. To do so, we examine the association between the industry average of *Independent_Directors* in year t and the percentage of firms in the industry with prior cartel involvement (i.e., firms prosecuted for price-fixing between the start of the sample period and year t). Industry affiliation is measured using four alternative

[20]See Farber (2005) for evidence of board changes that are meant to avoid recidivism in other types of corporate misconduct.

[21]The literature on board composition provides several arguments favoring the presence of more insiders in boards. Harris and Raviv's (2008) theory, for example, stresses that when inside directors have an information advantage, shareholders are better off by having boards heavily populated by insiders. Likewise, Raheja (2005) argues that it is optimal to have a higher proportion of insiders on the board when it is difficult for outsiders to verify projects. Duchin et al. (2010) empirically show that in industries where the cost of information acquisition is high, performance worsens when outsiders are added to the board.

[22]To test this formally, we perform a Kolmogorov-Smirnov test. The result makes it impossible to rule out the hypothesis that the two *Independent Directors* samples are drawn from the same distribution.

[23]Firms could also decrease the number of independent directors in anticipation of collusive behavior. While possible, in parallel to our previous reasoning we note that this potential effect can easily be offset by other factors calling for a higher presence of independent directors on boards.

approaches: the Fama French 12 industry classification; the Fama French 48 industry classification; 2-digit SIC codes; and 4-digit SIC codes. As shown in Table 10, board independence is higher in industries with higher rates of prior cartel prosecutions. The relevant coefficient ranges between 0.18 and 0.30 (depending on the criteria used for industry clasification), implying that a one-standard deviation increase in the number of industry firms with prior cartel involvement is associated with a subsequent increase of between 1.6% and 2.7% in the average percentage of independent directors on the boards of the firms in that industry.

TABLE 10 ABOUT HERE

For more direct evidence of board adjustments after cartel prosecution, we examine whether independent directors are replaced from their board seats in cartel firms after those firms are prosecuted.[24] Untabulated results show that cartel indictments are followed by independent director departures from prosecuted firms. In particular, the coefficient of interest is 0.03 (the t-statistic is 4.84) implying that a one-standard deviation increase in *Cartel_Involvement* is associated with an increase in departure probability of 0.4%. This is a significant figure given the unconditional average probability of director departure in the BoardEx universe. Together with the results in Table 10, these findings show that firms charged with cartel misbehavior subsequently appoint new independent directors. While descriptive, these results point to corporate governance responses that favor higher independence standards following cartel scandals.

7 Concluding Remarks

Price-fixing schemes cost billions of dollars to the public every year, and antitrust authorities debate ways to address this problem. Our study sheds light on the role

[24] In particular, using the universe of independent directors in BoardEx we analyze the firm-level determinants of director turnover over the sample period. The dependent variable *Departure* equals one if the independent director departed from a company in year $t+1$, and zero otherwise. On the right-hand side, *Cartel_Involvement* equals one if the firm received a cartel indictment in year t, and zero otherwise. The model includes a comprehensive set of controls: *Age*, *NBoards*, *Size*, *BM*, *Stock_Return*, *ROA*, and *Leverage* (see Appendix A for variable definitions).

individual market penalties can play in cartel prosecution. It does so by focusing on a particular class of professionals in the modern corporation: independent board directors.

We start by analyzing the stock market reaction to news of cartel indictments. Firms with a higher proportion of independent directors serving on their boards exhibit less negative returns. Notably, our evidence suggests that those independent directors that play a role in cartel prosecution are less likely to have been appointed under the scandal-laden CEOs' influence. That is, the degree of director independence matters around price-fixing investigations. We further explore whether reputational losses at outside directorships provide incentives for directors to deviate from cartel schemes by examining the ex-post effect of cartel prosecution on those directors' unprosecuted directorships. Our evidence shows that directors of prosecuted firms lose board positions and voting support across their portfolio of directorships.

To better understand the association between cartel-busting news announcement returns and the proportion of independent directors, we look at directors' actions following cartel prosecutions. Firms with a higher proportion of independent directors are more likely to apply for leniency. Moreover, after news of prosecution, there is a higher frequency of CEO departure among firms with a higher proportion of independent directors.

Our results are consistent with the argument that independent directors' reputational incentives play a role in cartel prosecution efforts. The analysis we present contributes to the debate on antitrust policies by providing evidence on measurable, significant market sanctions onto individuals involved in price-fixing schemes. We believe the results of our study are relevant to regulators designing and enforcing antitrust policies and to market participants seeking to understand the role of corporate governance and antitrust regulation on firm value and corporate behavior.

We conclude with three caveats about the interpretation of our results. First, while our evidence suggests that there exist individual market penalties associated with cartel involvement, our results do not necessarily mean that these penalties are large enough to stop the formation of price-fixing schemes among firms in the first place. Second, we

caveat against interpreting the results we report as supportive of the view that independent directors enhance firm value unconditionally. While our study documents one specific, contextual benefit of the presence of independent directors, our tests do not speak of the net wealth effect of independent directors on firm wealth. Finally, we note that conclusions about the net effect of independent directors' actions on shareholder or consumer wealth should be drawn with caution. Regarding shareholder wealth, one could argue that shareholders of cartel firms would have been better off (e.g., enjoy higher profits) if the cartel activity had been kept secret at the risk of more severe penalties if discovered. Regarding consumer wealth, the caveat is that independent directors could somehow also play a role in facilitating the firm to engage in cartel activity. Although we find no evidence that firms with more independent directors are more likely to participate in cartels, our inferences are limited by the possibility that some cartels were never discovered.

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Table 1
Summary Statistics
This table reports descriptive statistics for our sample of firms prosecuted for cartel participation between 2002 and 2012. Panel A presents the industry distribution of the sample firms. Panel B reports descriptive statistics about selected characteristics of the sample firms. Panel C reports descriptive statistics about characteristics of the cartels in which the sample firms are involved. See Appendix A for variable definitions.

Panel A. Industry Distribution

Fama-French 12 industry groups	% of firms
Business equipment	6.25%
Chemicals and allied products	9.38%
Consumer durables	5.73%
Oil, gas, and coal extraction and products	3.13%
Healthcare, medical equipment and drugs	8.33%
Manufacturing	14.06%
Financial firms	18.75%
Consumer nondurables	9.90%
Other	14.06%
Wholesale, retail, and some services	7.29%
Telephone and television transmission	2.08%
Utilities	1.04%
Number of firms	192

Panel B. Firm Characteristics

Variables	Mean	Median
Independent_Directors	0.76	0.80
MV (millions)	43,528	10,813
BM	0.53	0.44
Stock_Return	0.02	0.01
ROA	0.01	0.01
Leverage	0.25	0.24
Volatility	0.02	0.02
Firm-years with cartel prosecution announcements	520	

Panel C. Cartel Characteristics

Variables:	Mean	Median
Number_Participants	7.67	6
Duration	6.18	5
Cartel_Sales	49,084	3,870
Fines_Cartel	138	6.58
Jurisdiction:		
USA	0.43	0
European Union	0.33	0
Canada	0.15	0
Other	0.58	1
Number of cartels	200	

Table 2
Abnormal Returns on Prosecution Announcement Days
This table presents results of analyzing cross-sectional variation in abnormal returns around news of cartel prosecution. The dependent variable *Abnormal_Return* is the market-adjusted return on the dates of the first notices of cartel investigations (expressed as a %). The rest of the variables are as defined in Appendix A. The table presents the coefficient and t-statistic (in parentheses) for each variable in the regression specification. Standard errors are clustered at the cartel level.

Dependent Variable:	*Abnormal_Return*			
Independent Variables:	(1)	(2)	(3)	(4)
Independent_Directors	3.44***	3.09***	3.23***	3.26***
	(2.89)	(3.60)	(4.29)	(4.50)
FirmControls				
Size	0.03	0.01	0.03	0.04
	(0.48)	(0.10)	(0.45)	(0.57)
BM	0.08	0.09	0.13	0.16
	(0.46)	(0.51)	(0.80)	(0.96)
Stock_Return	0.69*	0.78**	0.78**	0.75**
	(1.89)	(2.17)	(2.43)	(2.35)
CartelControls				
Number_Participants		0.03	–0.10	–0.03
		(0.12)	(–0.45)	(–0.12)
Duration		0.16	0.20	0.33
		0.52	(0.78)	(1.26)
Cartel_Sales		–0.02	–0.05	–0.06
		(–0.22)	(–0.74)	(–0.90)
Fines_Cartel		–0.11	–0.10	–0.06
		(–1.61)	(–1.34)	(–0.84)
Industry-Fixed Effects			YES	YES
Jurisdiction-Fixed Effects				YES
Observations	547	547	547	547
R-squared	0.06	0.07	0.07	0.08

*** p-value<0.01, ** p-value<0.05, * p-value<0.10

Table 3
Sources of Variation in the Percentage of Independent Directors
This table presents results of the association between prosecution announcement returns and sources of variation in the percentage of independent directors. The dependent variable *Abnormal_Return* is the market-adjusted return on the dates of the first notices of cartel investigations (expressed as a %). *Independent_Appointments* is computed as the number of independent directors appointed under the circumstances listed below divided by the total number of directors. (1) *Appointed at the passage of SOX* equals one if the appointment of the independent director occurred in 2002 (year of the passage of Sarbanes Oxley) and if the audit committee was not fully independent at the start of 2001, and zero otherwise. (2) *Appointed before the CEOs tenure* equals one if the appointment of the independent director occurred before the appointment of the current CEO, and zero otherwise. (3) *Appointed in difficult times* equals one if the industry returns over the 12 months prior to the appointment of the independent director are negative, and zero otherwise. (4) *Appointed after class action suits* equals one if the firm was subject to shareholder litigation during the 12 months prior to the appointment of the independent director, and zero otherwise. These circumstances reflect situations in which the appointment is less likely to be driven by current management's personal interests. In model (1), *Independent_Appointments* is computed as the number of independent directors appointed under at least one of the circumstances listed above divided by the total number of directors. In model (2), *Independent_Appointments* is computed as the number of independent directors appointed under at least two of the circumstances listed above divided by the total number of directors. In model (3), *Independent_Appointments* is computed as the number of independent directors appointed under at least three of the circumstances listed above divided by the total number of directors. *FirmControls* includes *Size*, *BM*, and *Stock_Return*. *CartelControls* includes the logarithmic transformations of *Number_Participants*, *Duration*, *Cartel_Sales*, and *Fines_Cartel*. All these variables are defined in Appendix A. The table presents the coefficient and *t*-statistic (in parentheses) for each variable in the regression specification. Standard errors are clustered at the cartel level.

Dependent Variable:	*Abnormal_Return*		
Number of circumstances:	*At least 1*	*At least 2*	*At least 3*
Independent Variables:	(1)	(2)	(3)
Independent_Appointments	1.01**	1.60*	3.92*
	(2.34)	(1.93)	(1.68)
FirmControls	YES	YES	YES
CartelControls	YES	YES	YES
Industry-Fixed Effects	YES	YES	YES
Jurisdiction-Fixed Effects	YES	YES	YES
Observations	547	547	547
R-squared	0.05	0.05	0.05

*** p-value<0.01, ** p-value<0.05, * p-value<0.10

Table 4
Effect of Prosecutions on Unprosecuted Competitors
This table presents results of analyzing the market reaction to news of cartel prosecution in unprosecuted peer firms. Peer firms are defined using Hoberg and Phillips (2010, 2016)'s textual analysis. The dependent variable *Abnormal_Return* is the market-adjusted return on the dates of the first notices of cartel investigations (expressed as a %). For each unprosecuted firm, the tests use two proxies for the probability of future prosecution, E[*Prosecution*]. In model (1) the proxy for E[*Prosecution*], *Future_Prosecution*, equals one if the firm is prosecuted in the future (i.e., if the firm appears in the PIC dataset in later prosecutions). In model (2) the proxy for E[*Prosecution*], *Fitted_Value*, is computed as the fitted value of a logit model explaining the probability of cartel prosecution (see Appendix D). *FirmControls* includes *Size*, *BM*, and *Stock_Return*. *CartelControls* includes the logarithmic transformations of *Number_Participants*, *Duration*, *Cartel_Sales*, and *Fines_Cartel*. All these variables are defined in Appendix A. The table presents the coefficient and t-statistic (in parentheses) for each variable in the regression specification. Standard errors are clustered at the cartel level.

Dependent Variable:	*Abnormal_Return*	
Proxy for E[*Prosecution*]:	*Future_Prosecution*	*Fitted_Value*
Independent Variables:	(1)	(2)
E[*Prosecution*]	–2.35***	–0.40***
	(–3.54)	(–2.51)
*Independent_Directors**E[*Prosecution*]	2.73***	0.55***
	(3.30)	(2.85)
Independent_Directors	–0.29	1.58**
	(–1.27)	(2.51)
FirmControls	YES	YES
CartelControls	YES	YES
Industry-Fixed Effects	YES	YES
Jurisdiction-Fixed Effects	YES	YES
Observations	11,898	11,898
R-squared	0.01	0.01

*** p-value<0.01, ** p-value<0.05, * p-value<0.10

Table 5
Ex-post Departures from Unprosecuted Directorships
This table presents results of testing the effect of cartel involvement on the probability of director departure from unprosecuted (non-cartel) directorships. For each director-firm pair in year t, *Departure_NonCartel*, equals one if the director departs from that directorship in year t+1, and zero otherwise. The treatment group includes non-cartel directorships of cartel directors in prosecution years. The table presents results of comparing *Departure_NonCartel* between the treatment group and four control groups. Test (1) compares the treatment group to all director-firm-year observations with non-missing data in BoardEx in the sample period in which the firm and the director are not involved in cartel prosecutions. Test (2) compares the treatment group to a sample of director-firm pairs obtained from the universe of (non-cartel) director-firm-year observations in BoardEx using propensity-score matching. Test (3) compares the cartel directors in prosecution years to cartel directors in non-prosecution years. Test (4) compares the treatment group to (non-cartel) directors serving on the cartel directors' non-cartel directorships in prosecution years. The table presents mean values of *Departure_NonCartel* for the treatment and control groups. p-values of parametric (t-test) and non-parametric (Wilcoxon) tests of the difference in the distribution of *Departure_NonCartel* between treatment and control groups are in parenthesis for each of the four control groups.

		Control Groups			
Dependent Variable: *Departure_NonCartel*	*Treatment Group*	*Boardex Universe of non-cartel firm-director-years* (1)	*Propensity-Score (Matched on firm & director controls)* (2)	*Cartel Directors themselves (in-non-prosecution years)* (3)	*Co-directors at non-cartel boards (in prosecution years)* (4)
Mean	0.11***	0.08***	0.09***	0.09***	0.10***
(p-value)	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
H_0: Treatment = Control					
Parametric p-value		[0.001]	[0.001]	[0.001]	[0.055]
Non-parametric p-value		[0.001]	[0.002]	[0.001]	[0.056]
Observations	4,453	350,436	4,453	23,708	31,574

*** p-value<0.01, ** p-value<0.05, * p-value<0.10

Table 6
Voting Support

This table presents results of OLS tests of the effect of cartel involvement on directors' voting support. For each firm-director pair and each annual meeting in year t, $\Delta Support\_NonCartel$ is computed as the percentage voting support at the annual meeting held in year t minus the percentage voting support at the annual meeting held in year t–1. The treatment group includes non-cartel directorships of cartel directors in prosecution years. The table presents the results of comparing $\Delta Support\_NonCartel$ between the treatment group and four control groups. Test (1) compares the treatment group to all director-firm-year voting observations with non-missing data in BoardEx in the sample period in which the firm and the director are not involved in cartel prosecutions. Test (2) compares the treatment group to a sample of director-firm pairs from the universe of (non-cartel) director-firm-year observations in Voting Analytics obtained using propensity-score matching. Test (3) compares cartel directors in prosecution years to cartel directors in non-prosecution years. Test (4) compares the treatment group to (non-cartel) directors serving on the cartel directors' non-cartel directorships in prosecution years. p-values of parametric (t-test) and non-parametric (Wilcoxon) tests of the difference in the distributions of $\Delta Support\_NonCartel$ between treatment and control groups are in parenthesis for each of the four control groups.

		Control Groups			
Dependent Variable: $\Delta Support\_NonCartel$	*Treatment Group*	*Boardex Universe of non-cartel firm-director-years* (1)	*Propensity-Score (Matched on firm & director controls)* (2)	*Cartel Directors themselves (in-non-prosecution years)* (3)	*Co-directors at non-cartel boards (in prosecution years)* (4)
Mean	–1.04***	–0.05	–0.12	–0.15	–0.12
(p-value)	[0.001]	[0.352]	[0.642]	[0.257]	[0.291]
H_0: Treatment = Control					
Parametric p-value		[0.001]	[0.014]	[0.002]	[0.001]
Non-parametric p-value		[0.001]	[0.003]	[0.001]	[0.001]
Observations	980	26,318	980	3,419	4,634

*** p-value<0.01, ** p-value<0.05, * p-value<0.10

Table 7
Leniency Applications
This table presents results of OLS tests of the association between the probability of applying for leniency and the presence of independent directors on the board. The dependent variable *Leniency* equals one if the company applies for leniency, and zero otherwise. *FirmControls* includes *Size*, *BM*, *Leverage*, *Stock_Return*, *ROA*, and the natural logarithm of *Volatility*. *CartelControls* includes the logarithmic transformations of *Number_Participants*, *Duration*, *Cartel_Sales*, and *Fines_Cartel*. All these variables are defined in Appendix A. The table presents the coefficient and *t*-statistic (in parentheses) for each variable in the regression specification. Standard errors are clustered at the cartel level.

Dependent Variable:	*Leniency*			
Independent Variables:	(1)	(2)	(3)	(4)
Independent_Directors	0.22**	0.16**	0.15*	0.15*
	(2.54)	(1.94)	(1.78)	(1.79)
FirmControls	YES	YES	YES	YES
CartelControls		YES	YES	YES
Industry-Fixed Effects			YES	YES
Jurisdiction-Fixed Effects				YES
Observations	585	585	585	585
R-squared	0.12	0.18	0.22	0.24

*** p-value<0.01, ** p-value<0.05, * p-value<0.10

Table 8
Ex-post CEO Departure

This table presents results of OLS tests of the association between CEO departure after cartel prosecution announcements and the presence of independent directors on the board. The dependent variable, *CEO_Departure*, equals one if the CEO leaves the firm during the 12 months after prosecution news, and zero otherwise. *Independent_Directors* is the percentage of independent directors on the board. *Cartel_Involvement* is a dummy variable that equals one if the firm received a cartel indictment in year t, and zero otherwise. Column (1) includes cartel firms. Column (2) includes peers of cartel firms defined using Hoberg and Phillips (2010, 2016)'s textual analysis. Column (3) tests the difference on the coefficients on *Independent_Directors* between cartel and peer firms. *FirmControls* includes *Size*, *BM*, *Stock_Return*, *ROA*, *Leverage*, and the natural logarithm of *Volatility*. *CartelControls* includes the logarithmic transformations of *Number_Participants*, *Duration*, *Cartel_Sales*, and *Fines_Cartel*. All these variables are defined in Appendix A. The table presents the coefficient and t-statistic (in parentheses) for each variable in the regression specification. Standard errors are clustered at the cartel level.

Dependent Variable:	*CEO_Departure*		
	Cartel firms	*Peer firms*	*Pooled*
Independent Variables:	(1)	(2)	(3)
Independent_Directors	0.16**	0.01	0.01
	(2.35)	(0.84)	(0.86)
*Independent_Directors*Cartel_Involvement*			0.15**
			(2.12)
Cartel_Involvement			–0.09**
			(–1.95)
FirmControls	YES	YES	YES
CartelControls	YES	YES	YES
Industry-Fixed Effects	YES	YES	YES
Jurisdiction-Fixed Effects	YES	YES	YES
Observations	520	11,116	11,636
R-squared	0.01	0.01	0.01

*** p-value<0.01, ** p-value<0.05, * p-value<0.10

Table 9
Cartel Survival
This table presents results of estimating the association between cartel duration and the presence of independent directors on the board. The table presents results of the determinants of the survival function of the cartel over the sample period. *Independent_Directors* is the cartel-level average of the number of independent directors on the board of a firm scaled by the total number of board members. *FirmControls* is a vector of variables that includes the cartel-level mean of *Size*, *BM*, *Stock_Return*, *ROA*, *Leverage*, and the natural logarithm of *Volatility*. *CartelControls* includes the logarithmic transformations of *Number_Participants*, *Duration*, *Cartel_Sales*, and *Fines_Cartel*. All these variables are as previously defined except for *Duration* that is re-defined as the number of years between cartel formation and the start of the sample period. All these variables are defined in Appendix A. The table presents the coefficient and χ-square (in parentheses) for each variable in the regression specification.

Dependent Variable:	*Cartel Survival*			
Independent Variables:	(1)	(2)	(3)	(4)
Independent_Directors	–1.84**	–0.91*	–1.08**	–0.83*
	(8.69)	(2.65)	(4.13)	(3.43)
FirmControls	YES	YES	YES	YES
CartelControls		YES	YES	YES
Industry-Fixed Effects			YES	YES
Jurisdiction-Fixed Effects				YES
Observations	125	125	125	125
Log-Likelihood	–121.66	–99.10	–85.74	–69.68

*** p-value<0.01, ** p-value<0.05, * p-value<0.10

Table 10
Board Independence in Cartel Industries
This table presents results of OLS tests of the association between the average percentage of *Independent_Directors* at the industry level and the percentage of firms in the industry with prior cartel involvement. The dependent variable *Average % of Independent_Directors per industry* is measured as the industry-level mean of *Independent_Directors* per year. *% firms in the industry with prior cartel involvement* is the ratio of industry-level firms that appears in the PIC dataset in the prior years to the total number of firms in the industry. Columns (1) to (4) show results for different industry definitions. In Column (1) industry is defined using the Fama French 12 Industry Classification. In Column (2) industry is defined using the Fama French 48 Industry Classification. In Column (3) industry is defined using the 2-digit SIC codes. In Column (4) industry is defined using the 4-digit SIC codes. The table presents the coefficient and t-statistic (in parentheses) for each variable in the regression specification.

Dependent Variable:	*Average % of Independent_Directors per industry*			
	Fama-French 12	Fama-French 48	2-digit SIC code	4-digit SIC code
Independent Variable:	(1)	(2)	(3)	(4)
% firms in the industry with prior cartel involvement	0.30***	0.28***	0.30***	0.18***
	(5.73)	(9.16)	(11.48)	(15.47)
Observations	132	539	752	4,329
R-squared	0.11	0.11	0.09	0.05

*** p-value<0.01, ** p-value<0.05, * p-value<0.10

Appendix A Variable Definitions

FirmControls:

MV: Equity market value (in million dollars) of the firm

Size: Natural logarithm of *MV*

BM: Book-to-market ratio. Book value of equity scaled by *MV*

Stock_Return: Stock return compounded over the fiscal year

ROA: Return on assets (operating income scaled by total assets) over the fiscal year

Leverage: Total liabilities divided by total assets

Volatility: Stock return volatility, computed as the standard deviation of daily returns over 365 days prior to fiscal year end

GovernanceControls:

Independent_Directors: Percentage of independent directors on the board

Independent_Appointments: Percentage of independent directors on the board appointed under the circumstances listed in section 4.2

Staggered: Indicator variable that equals one if the corporate directors have staggered terms and zero otherwise

Chair_Insider: Indicator variable that equals one if the chair of the board also holds an executive position, and zero otherwise

Busy_Directors: Number of outside directors who serve simultaneously on at least two boards scaled by the total number of directors

Age_69: Number of outside directors who are at least 69 years old scaled by the total number of directors

Indep_Director_Holdings: Number of shares held by outside directors scaled by the total number of shares outstanding

Institutional_Holdings: Number of shares owned by institutions scaled by the total number of shares outstanding

CartelControls:

Number_Participants: Number of firms involved in the cartel

Duration: Number of years from the beginning to the end of the cartel activities

Cartel_Sales: Total revenues of the cartel firms during the collusive period (in million dollars)

Fines_Cartel: Total fines imposed on the cartel firms (in million dollars)

CartelFirmControls:

Fines_Firm_Pct: Total fines imposed on the firm divided by the sum of the fines imposed on the cartel firms

Recidivism: Number of times the firm has been prosecuted for involvement in prior cartels

ProsectutionEffort:

Budget_Increase: Inflation-adjusted increase in the budget of the Antitrust Division of the DOJ

Punishment_Severity: Natural logarithm of the average fine imposed by the DOJ in that year

CollusionIncentives:

Number_Competitors: Number of firms in the firm's 4-digit SIC code

Herfindahl: Herfindahl index of the industry

Innovation: Industry average of the R&D expenses scaled by total assets

Barriers_to_Entry: Industry average of the PP&E expenses scaled by total assets

Cost_Assymmetry: Industry standard deviation of COGS scaled by total assets

Market_Power: Industry average of the selling margin, computed as (sales revenues – COGS) / sales revenues. Industry is defined by 4-digit SIC code

Heterogeneity: Industry standard deviation of the selling margin, computed as (sales revenues – COGS) / sales revenues. Industry is defined by 4-digit SIC code

Demand_Growth: Percentage increase of industry sales

Demand_Volatility: Standard deviation of industry sales as percentage of total assets

Demand_Elasticity: Correlation between percentage changes in industry sales and percentage changes in the sum of sales across all Compustat firms

Diversification: The number of business segments in which the company operates. Industry is defined by 4-digit SIC code

DirectorControls:

Age: Natural logarithm of one plus the age of the director

NBoards: Natural logarithm of one plus the number of directorships held by the director in a given year

Appendix B Additional Controls

Table B.1
This table presents results of analyzing cross-sectional variation in abnormal returns around news of cartel prosecution using a complete set of control variables. The dependent variable *Abnormal_Return* is the market-adjusted return on the dates of the first notices of cartel investigations (expressed as a %). *FirmControls* is a vector of variables that includes *Size*, *BM*, *Stock_Return*, *ROA*, *Leverage*, and *Volatility*. *GovernanceControls* includes *Staggered*, *Chair_Insider*, *Busy_Directors*, *Age_69*, *Indep_Director_Holdings*, and *Institutional_Holdings*. *CartelControls* includes the logarithmic transformations of *Number_Participants*, *Duration*, *Cartel_Sales*, and *Fines_Cartel*. *CartelFirmControls* includes *Fines_Firm_Pct*, and *Recidivism*. All variables are as defined in Appendix A. The table presents the coefficient and t-statistic (in parentheses) for each variable in the regression specification. Standard errors are clustered at the cartel level.

Dependent Variable:	*Abnormal_Return*			
Independent Variables:	(1)	(2)	(3)	(4)
Independent_Directors	2.78***	2.38***	2.12***	2.44***
	(3.10)	(3.18)	(3.08)	(3.74)
FirmControls				
Size	0.12	0.16	0.14	0.12
	(1.30)	(1.42)	(1.18)	(0.91)
BM	0.15	0.15	0.13	0.20
	(0.85)	(0.91)	(0.81)	(1.29)
Stock_Return	0.74**	0.64**	0.62**	0.57**
	(2.38)	(2.16)	(2.01)	(1.98)
ROA	1.45*	1.35*	1.58*	1.32
	(1.78)	(1.76)	(1.87)	(1.44)
Leverage	1.89***	1.98**	1.80***	1.89***
	(2.59)	(2.51)	(0.2.60)	(2.65)
Volatility	0.43	0.29	0.19	0.14
	(1.28)	(0.91)	(0.70)	(0.53)
GovernanceControls				
Staggered		–0.03	–0.09	0.00
		(–0.13)	(–0.36)	(0.01)
Chair_Insider		–0.03	–0.09	–0.09
		(–0.26)	(–0.06)	(–0.32)
Busy_Directors		0.05	–0.09	0.13
		(0.09)	(–0.17)	(0.24)
Age_69		-0.96	–1.11	–1.01
		(–0.89)	(–1.12)	(–0.97)
Indep_Director_Holdings		0.05	0.03	0.02
		(0.66)	(0.27)	(0.24)
Institutional_Holdings		1.28	1.57	1.07
		(1.28)	(1.75)	(1.30)
CartelControls				
Number_Participants			0.03	0.02
			(–0.13)	(0.12)
Duration			0.03	0.20
			(0.10)	(0.80)
Cartel_Sales			–0.07	–0.11
			(–1.05)	(–1.56)
Fines_Cartel			–0.04	0.02
			(–0.56)	(0.29)
CartelFirmControls				
Fines_Firm_Pct			–2.01**	–1.99**
			(–2.31)	(–2.13)
Recidivism			0.03	0.14
			(0.10)	(0.47)
Fixed Effects				
Industry-Fixed Effects				YES
Jurisdiction-Fixed Effects				YES
Observations	547	547	547	547
R-squared	0.09	0.10	0.13	0.15

*** p-value<0.01, ** p-value<0.05, * p-value<0.10

Appendix C Hoberg and Phillips Data Library

The Hoberg and Phillips industry classifications are based on web crawling and text analyzing algorithms that examine the text in the business descriptions of 10-K annual filings with the Securities and Exchange Commission. The database is based on all publicly traded firms (domestic firms traded on either NYSE, AMEX, or NASDAQ) for which there is COMPUSTAT and CRSP data.

Industry classifications are based on how firms describe their main products in the output markets. Thus, classifications are based on the products that firms supply to the market, rather than production processes. The Hoberg and Phillips computer-based algorithms create word usage vectors for each firm. These vectors contain the information on how firms are related to each other and are used to create a network representation of competition in the product markets. The framework provides a measure of product similarity between firms both within and across industries.

The Hoberg and Phillips Data Library contains two 10-K based industry classifications. The "Fixed Industry Classifications", or FIC, is comparable to SIC and NAICS industries. The FIC is based on the clusterings obtained for the earliest year when Hoberg and Phillips conducted their industry analysis (1997) and then holding these industries fixed. The second industry classification is more flexible and informative as it captures product market competition in a dynamic framework. The "Text-based Network Industry Classifications", or TNIC, allows product market definitions to change every year and industry membership is not constrained to be transitive as in the fixed industry classifications. The TNIC generates industries as time-varying intransitive networks. In this classification system, each firm has its own set of distinct competitors that varies over time.

Relative to existing industry classifications, the Hoberg and Phillips text-based methodology offers significant improvements as it is based on manager's descriptions of competitive pressures in their markets, the specific firms identified by managers as being competitors, and how advertising and R&D investments relate to product differentiation. Moreover, the TNIC possesses central properties that are not captured by traditional fixed industry classifications. The main properties of the TNIC are: (1) capturing variations in competitive rivalry among existing firms in an industry (i.e., some industry rivals exhibit a more intense competitive threat), (2) allowing for product and industry evolution over time (i.e., new products appear or change over time), and (3) gauging cross-industry competition (i.e., firms in very different traditional industries offer competing products to their customers). For an extensive description of the TNIC data please read the data and methodology sections of Hoberg and Phillips (2010, 2016).

In our analysis, we match the sample of cartel firms to the TNIC data on firm's competitors to identify those firms that are rivals of the indicted firms and we only keep those competitors that are not present in the PIC dataset in prior years.

Appendix D The probability of a cartel prosecution

We analyze the determinants of cartel prosecution taking into account a number of factors analyzed in previous research (e.g., Shapiro (1989) and Levenstein and Suslow (2006)). We estimate the following logit model:

$$\begin{aligned} Prosecution_{i,t} = \beta_0 &+ \beta_1 Independent\_Directors_{i,t-1} + \beta_2 FirmControls_{i,t-1} \\ &+ \beta_3 GovernanceControls_{i,t-1} + \beta_4 ProsecutionEffort_{i,t-1} \\ &+ \beta_5 CollusionIncentives_{i,t-1} + \epsilon_{i,t}, \end{aligned} \tag{D.1}$$

where i indicates the firm, t indicates the year of the prosecution. *Prosecution* equals 1 if firm i is involved in a cartel detected in year t, and 0 otherwise. The control group of non-prosecuted firms is formed by all the firms in the CRSP-Compustat universe, resulting in a panel of 32,592 observations. *Independent_Directors* is the percentage of independent directors on the board. *FirmControls* and *GovernanceControls* are previously defined vectors of variables measured at the start of the year. *ProsecutionEffort* includes two measures of regulatory effort to prosecute price-fixing cartels. The first is *Punishment_Severity*, which is the logarithm of the average fine imposed by the DOJ in the year. The second, *Budget_Increase*, is the inflation-adjusted increase in the budget of the Antitrust Division of the DOJ.

We include in Eq. (D.1) measures of conditions that lead firms to engage in price-fixing behavior (*CollusionIncentives*). The economic literature has identified a number of structural characteristics which make markets more prone to collusion. Price-fixing becomes more likely, the smaller the number of competitors; the higher the level of market concentration; with the existence of higher entry barriers and in industries that are more symmetric and or transparent. In creating empirical proxies for those predictions, we measure *Herfindahl* as the Herfindahl index of industry concentration.[25] *Innovation* is the industry average of the R&D expenses scaled by total assets. *Barriers_to_Entry* is the industry average of PP&E scaled by total assets. *Number_Competitors* is the number of firms in the industry. *Cost_Asymmetry* is the industry standard deviation of cost of goods sold (COGS) scaled by total assets. *Market_Power* is the industry average of the selling margin, computed as (sales revenues – COGS) / sales revenues. *Heterogeneity* is the industry standard deviation of the selling margin, computed as (sales revenues – COGS) / sales revenues.

We also include controls for demand conditions that favor collusion. Firms have more incentives to sustain collusion in growing markets (Rotemberg and Saloner (1986)) and in case demand elasticity is relatively low (as the gain from "cartel prices" is larger). We measure *Demand_Growth* as the percentage increase of industry sales. *Demand_Volatility* is the standard deviation of industry sales as percentage of total assets. *Demand_Elasticity* is the correlation between percentage changes in industry sales and percentage changes in the sum of sales across all firms. Finally, as prior literature argues that multi-market contacts among firms favor collusion (Bernheim and Whinston (1990)), we also include a measure of the degree of business diversification of the company. *Diversification* is defined as the number of business segments in which the company operates.

[25] All industry variables are computed using 4-digit SIC codes.